PATENT SPECIFICATION

761,511

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COMPLETE SPECIFICATION

Improvements in or relating to a Method for Simultaneously Processing a Plurality of Yarns

We, INDUSTRIAL RAYON CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of 660, Union Commerce Building, Cleveland, State of Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method for processing yarns and particularly to a method for simultaneously processing a plurality of yarns. More specifically, the invention relates to a method for handling a plurality of at least two yarns, initially separately formed, but thereafter conducted as a unitary bundle or strand, over a yarn-storing, yarn-advancing device or a plurality of such devices in the form of a helix subjected to one or more treatments, then separated and collected as individual yarns.

Generally, in the manufacture of viscose rayon by the continuous process, it is the custom to form and then after-treat a single yarn composed of a plurality of filaments. During processing, such a yarn is advanced over a consecutive plurality of yarn-storing and advancing reels in the form of a helix. While in the form of a helix, various after-treatments are applied to the yarn to finally yield a product having desired characteristics. Thus, yarn is spun, after-treated, and collected as a single yarn. It would, of course, be advantageous and economical to spin or handle a plurality of separate yarns as a single strand over the same yarn-storing, yarn-advancing reels.

A further advantage in processing a plurality of yarns in the form of a unitary bundle or strand over a reel is the ability of such a strand to clear the reel of broken filaments, i.e. stray or fugitive filaments, and thus to reduce yarn breakage. Where under normal circumstances a single yarn would be processed and filaments become broken during its helical travel over a reel the broken filaments would quickly build up to form a wrap which would eventually break the yarn. Where a plurality of yarns are advanced over a reel then each assists in carrying away or stripping off stray or broken filaments before causing complete breaks.

Various methods have been suggested for the handling of a plurality of yarns over the same helix forming and advancing reels. Generally all of these proposals teach that the separate yarns are maintained apart and out of contact with each other and that no over-lapping of turns should occur while being advanced over a reel. These proposals show the utilization of additional and specific yarn guiding and handling devices usually before and after a reel, and provide that the reel itself should be of a critical construction so as to prevent an overlap of the separate yarns being advanced. Bundling of yarns by these proposals is avoided because of over-winding or under-winding of the thread turns and resultant breakage.

In accordance with this invention there is provided a method for simultaneously processing a plurality of yarns, characterized by the fact that it comprises simultaneously drawing a plurality of separate yarn ends, bringing said yarn ends together to form a bundle after treating one or more of the ends in such a manner as to facilitate ultimate separation of the ends, advancing said bundle through a helical path, meanwhile subjecting the yarn to the desired processing, then separating said bundle into the original constituent yarns, and collecting said separated yarns.

The treatment applied to the one or more of the yarn ends before the yarn bundle is formed is one which imparts a distinguishing physical characteristic so as to facilitate ultimate separation of the yarns. In the preferred form of the invention, this treatment comprises imparting a separate twist to each of the yarn ends before bringing them together as a bundle. In another form of the invention the surface characteristics of one or more of the yarns is altered before forming of the bundle.

[*Price 3s. 0d.*]

The advantages of this invention will become apparent from the following detailed description and the accompanying drawings where:

Figure 1 represents a continuous viscose rayon spinning apparatus adapted to handle a plurality of yarns in one form of the method of the invention;

Figure 2 shows the adaptability of the apparatus of Figure 1 for handling a plurality of formed yarns for processing;

Figure 3 shows apparatus generally similar to that of Figure 1 but modified for use in another form of the invention;

Figure 4 is a section on line 4—4 of Figure 3;

Figure 5 shows an apparatus for separating the yarn bundle; and

Figure 6 shows a modification of the apparatus of Figure 5.

Referring to Figure 1 of the drawing there is shown in abbreviated form an apparatus for the continuous spinning of viscose rayon. A plurality of rotating spinnerets, 10, 11, 12 are positioned in an acid coagulating bath contained in trough 13, and from each there is extruded a viscose solution which is regenerated by the bath to form yarns 15, 16, 17. The spinnerets are positioned in rotating mass tubes 18, 19, 20, being driven through gears 21, 22, 23, respectively, by the common drive shaft 24. The formed yarns 15, 16, 17 are twisted at the time of extrusion at a slow rate, a turn may be imparted at about every 200 to 600 inches of travel. The three separate twisted yarns are then passed about a rotating roll 25 supported in the trough 13 rotating at a rate correlated to the rate of extrusion of the viscose solution and to the rate of take-up of the yarns by the reel 26 positioned above the trough 13.

The three twisted yarns 15, 16, 17 are led from the bath to the take-up reel 26, each being laid thereon at about the same point on the reel surface to form a single enlarged yarn or strand for further advance in the form of a helix. From reel 26 the strand 28 is then led to and advanced over subsequent reels 29 . . . 30 for further processing, and thereafter it is divided into the individual yarns 15, 16, 17. Upon leaving the drier reel 30 the strand 28 is passed through guide 32 then separated into individual original yarns each passing through the related guides 33, 34 and 35 to individual take-ups 37, 38, 39 where each is wound into a package.

The strand 28, formed of the three yarns 15, 16, 17, while on the reels 26, 29, . . . 30 and while in the form of a helix, can be subjected to a desired liquid treatment or treatments that ordinarily are applied to viscose rayon yarns such as wash treatments, desulfurizing and bleaching. The treatments are generally applied through tubes 40, 41, 42, the liquids spreading over and blanketing the strand helix, each yarn being equally subjected to the treatment so that upon subsequent separation each will have uniform and similar final characteristics. After liquid processing the final treatment on the strand is that of drying. As shown, drying of the strand 28 is performed on the last reel 30 through which steam is circulated. The strand 28 is then led through guide 32 beyond which it is divided into the individual yarns 15, 16, 17, each yarn being advanced to its respective collecting device 37, 38, 39, after first passing through its respective guide 33, 34, 35.

The reason for imparting a twist into the yarns 15, 16, 17 is to enable their separation after the strand 28 leaves the drier reel 30. One method successfully utilized to separate out the yarns is to thrust a sharp pointed instrument, such as a pin, into the travelling strand 28 to thus effect a backing up of the twist, or forming a node, at that point in the particular strand portion or in the particular yarn of said strand where it is pierced. This backed-up twist substantially immediately contains the twist and thus groups the filaments of the particular yarn as if tying them together by means of a knot. Another method, which will be described in more detail in connection with the subsequent discussion of the separating apparatus shown in Figures 4 and 5, is one where the composite strand is flattened while running over an arcuate or convex surface under a slight tension, the spread filaments are gathered or sorted by the twist into the component yarns and an interjection of a pointed or serrated instrument readily divides out the specific yarn. The individualized yarn is then temporarily passed to an air aspirator tube collecting device (not shown) leaving the operator free to effect the further division of the remaining two yarns. Once a separation of the three yarns is effected they are then passed on to their winding or collecting devices.

It has been found that there exists a relationship between the running speed of the strand bundle and the number of turns of twist for separation purposes. In general, lower twists per unit length are employed at the higher strand speeds. Thus, for example, at strand speeds of about 60 to 100 meters per minute, speeds usually employed in continuous spinning and processing methods, it is advantageous to employ one twist in lengths ranging from about 200 inches to 600 inches. For speeds lower than 60 meters per minute or for about 20 to 50 meters one may employ a twist for a shorter running strand length, e.g. ranging from about 60 to 180 inches. Also, a low twist advantageously permits the laying of the yarns, while in the strand, in a generally parallel manner for more effective processing. Furthermore, a twist in the yarn also will tend to restrict broken filaments to the original yarn body as the strand passes over the reel. The remaining yarns in the strand also assist in helping to keep the reel clean of possible fugitive wraps.

In Figure 2 of the drawing there is shown a modification of the source of supply of yarns which are formed into a strand for subsequent processing over a plurality of reels. At least three supply packages 41, 42, 43 of flat wound yarn are positioned in a creel 44 (generally shown). The flat wound yarn is withdrawn over-end through guides 46, 47, 48 positioned ahead of them then through gathering guide 49 where the yarns are combined into a strand 50 which is led through another guide 51 onto a reel 52, and thence onto subsequent reels 53 . . . While on reels 52, 53 . . . the strand 50 can be subjected to various desired processing treatments then later separated into individual yarns in the manner hereinbefore described, and wound on separate bobbins by separate collecting means. Where yarn is withdrawn from packages and the twist is more frequent the rate of strand travel is slower, lower drawing speeds are necessary for purposes of later separation.

Referring to Figure 3 of the drawing there is shown an example of apparatus used in the form of the invention where ultimate separation of the yarns in the yarn bundle is facilitated by altering the surface characteristics of one or more of the yarns.

Referring to Figure 3 there are positioned in a trough 60 containing an acid coagulating bath spinnerets 61 and 62 extruding a viscose solution to form yarns 63 and 64. The spinnerets are shown relatively widely spaced apart for illustration only, and if used as shown a gathering guide would have to be provided. To yarn 63 there is applied a solution of zinc sulfate through the applicator 68. Any excess is picked-up by the angularly positioned trough 69 to be dropped into a further separate trough 70 for subsequent reaction. The treated yarn 63 and the untreated yarn 64 are then combined as shown and led as a single strand of generally parallel filaments over the take-up yarn storing and yarn advancing reel 65. The strand formed of the combined yarns 63, 64 is then led to subsequent yarn advancing devices 71—74, on which may be performed such other applications or treatments that will provide for the kind of yarn desired in the final analysis.

The final treatment given the strand 63, 64 is generally that of drying. The yarn advancing and yarn storing reel 74 is heated by circulating steam through its interior as for instance through the steam inlet pipe 75 and exhausted through the annular steam outlet 76. After being dried the strand 63, 64 is led through a central guide 78, see also Fig. 4, and from there the strand is separated into its component yarns 63 and 64 which are then led through guides 79, 82 to separate collecting devices 80 and 84.

The application of the zinc sulfate solution to yarn 63 prior to its take-up by reel 65 continues only for such periods so as to permit the lacing or threading-up of the reels and effecting a separation of the strands 63, 64 at the guide 78. Once the machine is laced-up the application of the zinc sulfate solution is discontinued and the yarns 63, 64, having been extruded separately and coagulated separately continue to maintain their individual characteristics during normal spinning.

Zinc sulfate has been mentioned as a yarn characteristic changing solution affecting a yarn as, for instance, a diameter change. A solution of sulfuric acid will also similarly affect the diameter of a yarn. Zinc sulfate is preferred since an occasional spilling of it into the bath will do no harm, or of the sulfuric acid solution, other compounds can also be utilized to alter the physical characteristic of a yarn but such other compounds will affect the coagulating bath if spilled into it. Such other compounds can be utilized with additional equipment guarding against adulteration of the coagulating bath.

EXAMPLE

In practice, yarns 63, 64 formed of a viscose solution and having a final determined denier of 75 each are wrapped around the take-up reel 65 without regard to separation. The bundle or strand of generally parallel yarns 63, 64 is advanced over the reel as a helix. Once the yarns have been secured to the reel a solution of concentrated zinc sulfate is applied to a yarn 63 prior to its take-up by the reel 65. A surface change in the yarn 63 is brought about by this application due to the dehydrating power or other action of the solution. The two unseparated although different yarns continue their advance over the subsequent reels 71, . . . 74, and through the guide 78 where they can be separated by means of a sharp instrument such as a pin since there is an apparent difference between the treated yarn 63 and the untreated yarn 64. An aspirating air tube (not shown) is temporarily used to continue the advance or take-up of the combined yarns until the operator divides them out. The division is readily effected because of yarn differentiation. Each yarn upon the division is collected temporarily by air aspirating tubes to waste and the application of the zinc sulfate solution is stopped. The separated yarns 63, 64 are then led through their twisting guides 79, 82 respectively and to be collected by the cap-twister devices 80, 84. Once the lacing-up of the spinning apparatus is made the yarns as identical yarns but as individual yarns are spun and aftertreated as a single enlarged yarn until after the drying treatment after which they are separated. For the short interval of time required by the lacing-up period the yarns are being subjected to the usual aftertreatments to which viscose yarns are subjected. As has been herein stated a solution of sulfuric acid can be substituted for zinc sulfate, if so desired.

In Figures 5 and 6 of the drawings there are shown two embodiments of apparatus which can be used to separate the bundle into its

original constituent yarns where, as in the case of Figures 1 and 2, the treatment to facilitate such separation involves a separate twisting of the yarns.

The yarn separating device of Figure 5 is formed of a generally U-shaped support 90 having a recessed base 91. The base 91 has an initial surface 92 that is smooth and rounded in the transverse direction. The surface then becomes gently serrated or undulated as at 93. There is positioned in the extensions or sides 94, 95 of the U support 90 a threaded bolt 96. The helical screw surface of the bolt 96 provides further well defined serrations which are utilized for final yarn separation.

The device of Figure 5 is brought into frictional contact with the yarn bundle or strand after the strand leaves the last processing reel; the surface 92 of the guide being first to frictionally contact the strand, then the undulations 93, and finally the serrations of the screw 96. When the strand is initially laid on the smooth surface 91 it is flattened out and the filaments in the respective yarns substantially immediately tend to regroup. The slight pressure on the strand thus effects an initial rough separation of the yarns because of a backing up of the twist in each of the yarns comprising the strand, the twist entwining and grouping the filaments of each yarn. The flattened yarns and the separated filaments are then separated to a greater extent by the undulations 93 beyond the smooth, initial contacting surface 92. The undulations tend to more definitely back up the twist by protruding into the spread yarns to divide out the constitutent filaments to the respective yarns. Once the separation is substantially effected by the undulations 93 the yarns are then passed over the screw 96 wherein they tend to find a recess and become bundled therein. Should a filament or several filaments from adjacent yarns become temporarily associated with another yarn then the twist in the yarn to which the filament rightfully belongs will draw it back into the yarn as it is backed up by the protrusion of the raised portion of the serrated surface into the spread yarns. In effect, the backed-up twist is like a knot about the filaments.

A modification of a strand separating device is shown in Fig. 6. The initial contacting surface 101 contained in the base of the U-shaped member 100 is rounded in the transverse direction and arcuate in the longitudinal direction. The arcuate surface 101 when in physical contact with the strand will cause the separation of the filaments spreading them and simultaneously backing up the twist in the running yarns by the frictional contact. The backing of the twist in the yarns effects a preliminary but substantial separation of the yarns by grouping. Immediately thereafter the preliminary grouped yarns are placed into contact with a comb 102 each moving yarn finding a recess therein. Should stray filaments occur then a tooth will effect a backing up of the twist in the particular yarn which will group its respective filaments. The comb 102 advantageously may be provided with a light coil spring 103 at one end to resist the backed up twist with only enough tension to maintain the comb in its upright position but to yield when a backed up twist passes over one of its teeth. The comb 102 also may be provided with a lever 104, if desired, to overcome the operation of the coil spring 103.

The devices of Figure 5 and Figure 6, because of their practicability, advantageously enable the processing of a plurality of fine denier yarns over the same reel or reels. The disadvantages heretofore encountered in processing a plurality of yarns over the same thread advancing devices where the yarns have to be kept apart in their travel over the reels are overcome through the use of the separating apparatus shown in Figures 5 and 6.

The process of the present invention may be employed for the treatment of continuous-filament yarns of all types—natural fibers, e.g. silk; artificial fibers, e.g. viscose rayon, cellulose acetate or other regenerated cellulose fibers; and also synthetic fibers, e.g. those made from linear polyesters, polyamides or polyacrylics such as vinyl polymers or copolymers including those made from acrylonitrile. The new process is particularly suited to continuous-spinning methods where the extrusion and subsequent fiber processing is performed in a continuous sequence of operations such as in certain viscose rayon and cuprammonium methods. The process, however, is also advantageously suited to those methods where the spinning continuity is interrupted after the extrusion and coagulation step. Such spinning methods are usually employed in the melt and dry-spinning fields because the extrusion speed is far in excess of the speed at which the coagulated or solidified fiber could be processed on thread-advancing devices. It is with these methods that the method of Figure 2 could be employed with advantage. Thus, for example, a melt-spun polyester or polyamide fiber is first collected as a flat yarn on a package at the rate of about 1000 meters per minute. A plurality of yarns from such packages, thereafter, can be subjected to one or more treatments on a series of thread-advancing devices travelling at 30 to possibly 150 meters per minute in accordance with the method of Figure 2. Among the yarn treatments that may be applied in accordance with this invention are applying regenerating or purifying liquids, washing with water to remove impurities; stretching, bleaching, dyeing, applying finishing or sizing materials, and drying. In the processing and after-treatment of viscose rayon which has been extruded into an acid coagulating bath, are the steps of dilute acid regeneration, stretching, washing with water,

desulfurizing, bleaching, oiling and drying.

By combining several yarns into a strand and processing them while in strand form low denier yarns advantageously can be spun and processed more economically on a continuous apparatus. A plurality of low denier yarns can be thus more effectively treated over a thread advancing reel and with less stoppage for breaks than could be heretofore done. Further, a strand of low denier yarns can be advanced over thread advancing devices without additional care in the design of reels that are ordinarily required for the processing of yarns.

What we claim is:—

1. A method for simultaneously processing a plurality of yarns, which comprises simultaneously drawing from a source a plurality of separate yarn ends, bringing said yarn ends together to form a bundle after treating one or more of the ends in such a manner as to facilitate ultimate separation of the ends, advancing said bundle through a helical path, meanwhile subjecting the yarn bundle to the desired processing, then separating said bundle into the original constituent yarns, and collecting said separated yarns.

2. A method according to claim 1, in which a distinguishing physical characteristic is imparted to the one or more of the yarn ends to facilitate ultimate separation of the ends.

3. A method for simultaneously processing a plurality of yarns which comprises bringing together as a single bundle at least two separate yarns, altering the surface characteristics of one of said yarns before combining into said bundle, advancing said bundle through a helical path, meanwhile subjecting the yarn bundle to the desired processing, separating said bundle into original individual yarns after it has passed through said helical path, collecting said yarns separately, and upon separation restoring the altered yarn to its original state in respect of its surface characteristics.

4. A method according to claim 3, in which the surface characteristics are altered by treating the yarn with a solution of zinc sulfate.

5. A method according to claim 3, in which the surface characteristics are altered by treating the yarn with a solution of sulfuric acid whereby the cross-section of the yarn is altered.

6. A method for simultaneously processing a plurality of yarns which comprises bringing together as a bundle at least two separately twisted yarns; advancing said bundle through a helical path while subjecting it to a yarn treatment; separating said bundle into the original constituent yarns after it has passed through said helical path; and collecting said yarns into separate packages.

7. A method according to claim 6, in which a low twist is applied to each of the yarns, e.g. (at usual yarn speeds), a twist having a length of from 200 inches to 600 inches.

8. A method according to claim 6 or 7, in which the bundle is separated by backing up the twist of each yarn and thereby bringing together the constituent filaments corresponding to each of the plurality of yarns.

9. A method according to claim 8, in which the running bundle of yarns is flattened to spread the filaments forming the yarns by passing the bundle over and in contact with a surface, and the twist of each yarn is backed up by thrusting the raised surface areas of a serrated surface into the running spread yarns.

10. A method according to claim 8, in which the running bundle of yarns is flattened to spread the filaments forming the yarns by passing the bundle over an arcuate surface which surface backs up the twist in each yarn, the substantially separated yarns being then passed over a serrated surface whose raised surface projections are thrust into the running yarns to more positively back-up the twist in each of said yarns.

11. A method according to claim 9 or 10, in which after the twist of each yarn has been backed up, the separated yarns are then separately laid in the depressed areas of the undulating or serrated surface.

12. A method according to claim 3 in which separation of the bundle into its original individual yarns is effected by passing the yarns over a support having a first surface which is adapted to substantially flatten the bundle and spread the filaments of the yarns and a second surface which is serrated so that its serrations are thrust into the passing yarns to thereby effect a backing up of the twist in each of said yarns.

13. A method according to claim 12, in which the surface for flattening the yarn bundle is arcuate.

14. A method according to claim 12, in which the surface for flattening the yarn bundle is smooth and the yarns are passed over a second serrated surface following the first serrated surface to further back up the twist in the yarns.

15. A method according to claim 13, in which the arcuate surface is smooth, and the serrated surface is provided by the projections of a rotatably mounted comb, resilient means being provided in the support for resisting rotation of said comb and a lever being provided for turning said comb.

16. A method for simultaneously processing a plurality of yarns substantially as hereinbefore described and as illustrated in the accompanying drawings.

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Fig. 1.

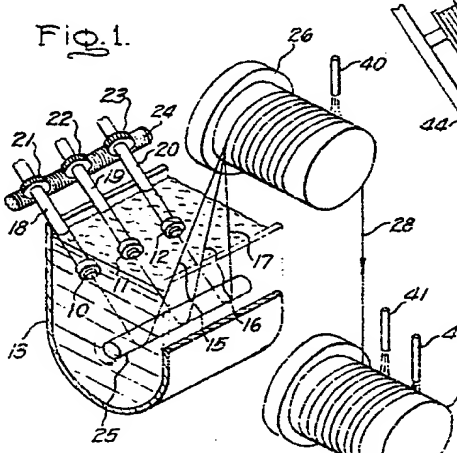
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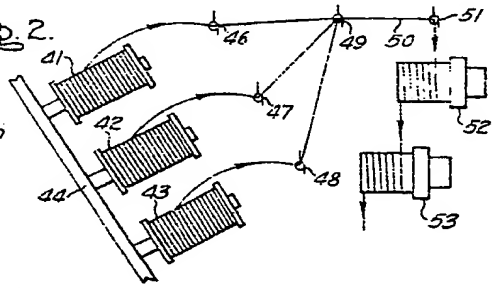
Fig. 2.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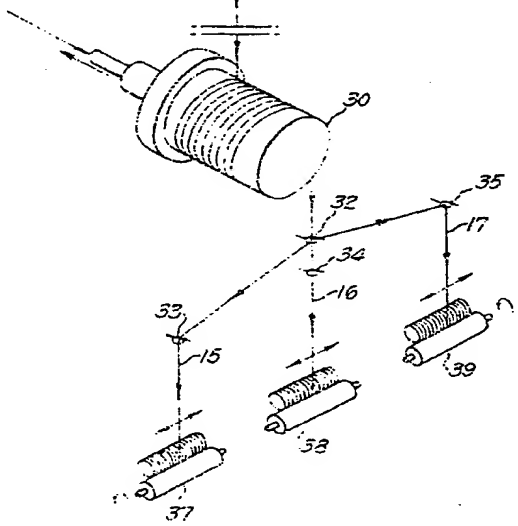
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761,511 COMPLETE SPECIFICATION

2 SHEETS

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SHEETS 1 & 2

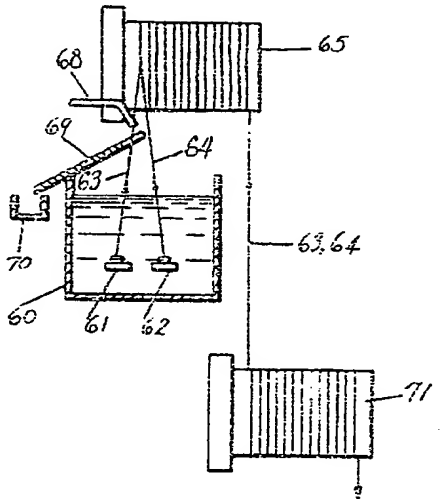


FIG. 3.

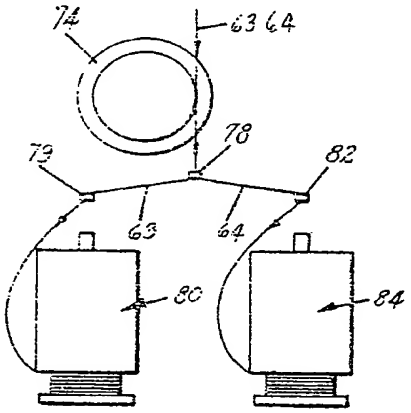


FIG 4.

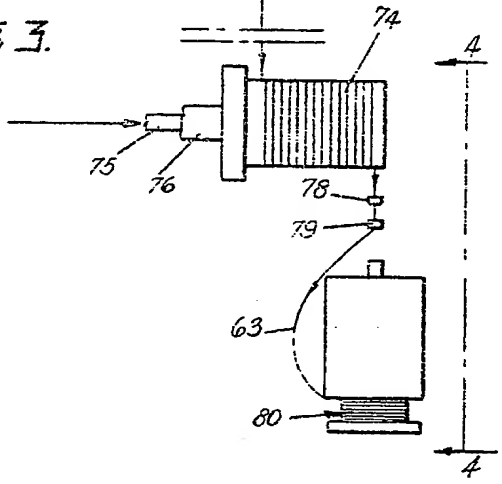


Fig. 5

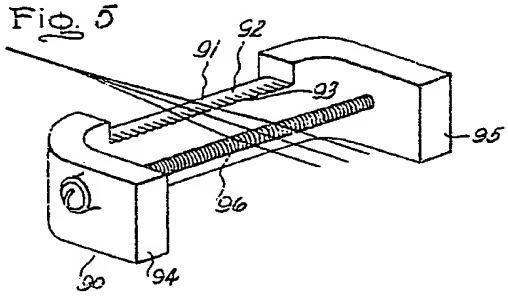
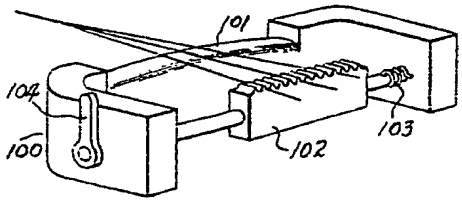


Fig. 6



761,511 COMPLETE SPECIFICATION

2 SHEETS

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SHEETS 1 & 2

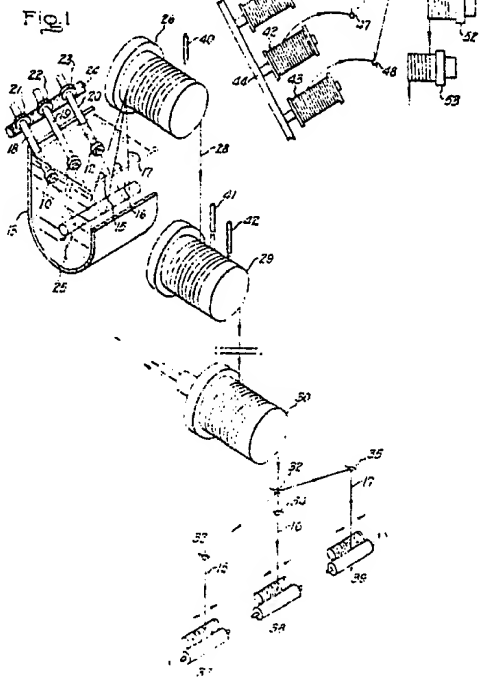

Fig. 1

Fig. 2.

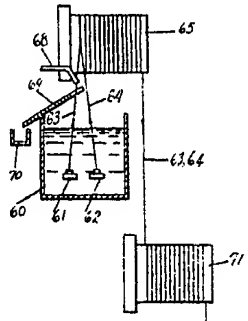

FIG. 3.

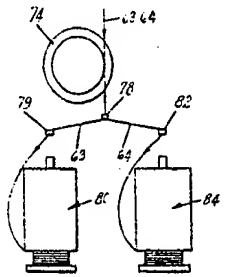

FIG. 4.

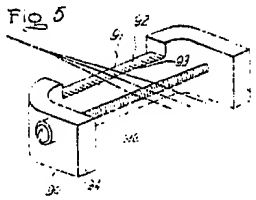

Fig. 5

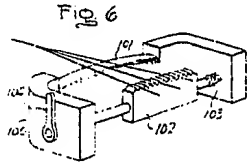

Fig. 6